Workshop on

" International Workshop on Application of Advanced Plant Information Systems for Nuclear Decommissioning and Life-cycle Management "

3 – 5 December 2018

Use of NPP Information Modelling for radiological characterization, waste estimation and planning removal of components

2018-12-04

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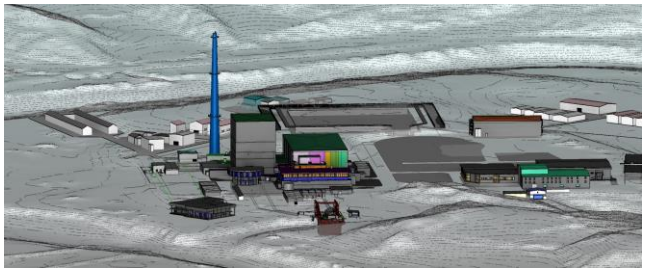
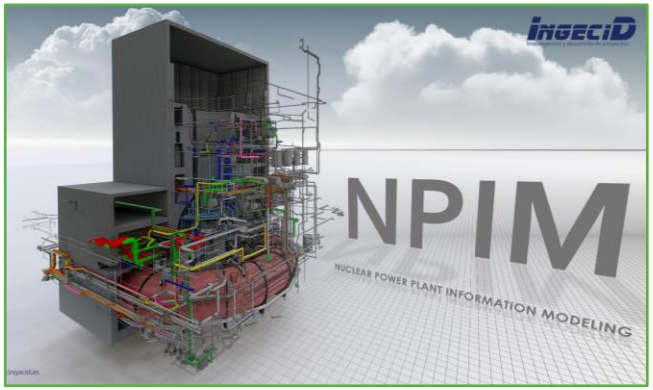
What is the NPPIM model?

- Parametrised 3D/BIM model of all the elements of the NPP
- Developed from drawings and isometric drawings
- Checked with 3D scan point cloud
- Integrated database that includes all the information with and without graphical representation
- Database + 3D model allows:
  - Obtain information of the SSC
  - Optimise planning
  - Provide support to waste, resources and space management
  - ...





Over the last years, the use of new technologies has grown exponentially, allowing the improvement of processes by reducing both, **time** and **cost** while increasing **safety**.

This digital evolution has been reflected in the use of new software for the design, construction, O&M and decommissioning of infrastructures, including nuclear power plants, where numerous agents participate and must collaboratively manage the information.

SPANISH NPP STATUS

	NPP	Start	Planned shutdown*	Status
Spain	Vandellós II	1988	2028	Operation
	Trillo	1988	2028	Operation
	Ascó II	1986	2026	Operation
	Ascó I	1984	2024	Operation
	Cofrentes	1985	2025	Operation
	Almaraz II	1984	2024	Operation
	Almaraz I	1983	2023	Operation
	Vandellós I	1972	1989**	Latency time, partially dismantled
	José Cabrera – Zorita	1969	2006	Under D&D
	Santa María de Garoña	1971	2012**	Permanently ceasing production D&D preparation

*Final planned under the assumption of 40 years of operation

**Shut down before completing 40 years of operation

90s

VANDELLÓS NPP DATA BASE

DB

Database developed with 3 types of elements

- **Buildings and external areas**
  - Zones
  - Surfaces
- **Systems**
  - Components or Equipment

Physical data (masses, area, material, etc.)

Results of radiological characterization

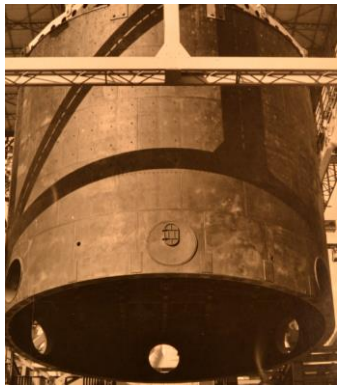
- Management of materials
- Management of radiological impact to public and workers

90s → 2015-2016

VANDELLÓS NPP 3D MODEL

3D of reactor caisson

- **Inputs**
  - Drawings
  - Photos
  - Documents

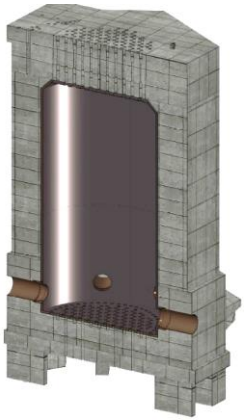


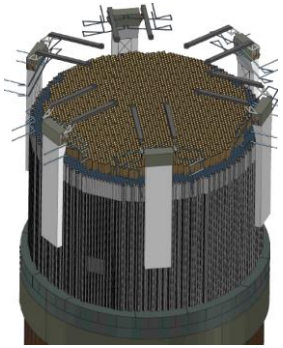
- **Flexibility**
  - Federated 3D model
  - Elements with material properties
  - Possibility of increasing the level of detail
- **Compatibility**
  - Autodesk Software
  - Exportation the 3D model to video maker software

90s

2015-2016

3D of reactor caisson





Main objective: Planning the decommisioning level 3

Main Applications

- Visual – video
- Calculations
- Radiological inventory assesment
- Simulations of dismantling works
- Segmentation and packaging examples

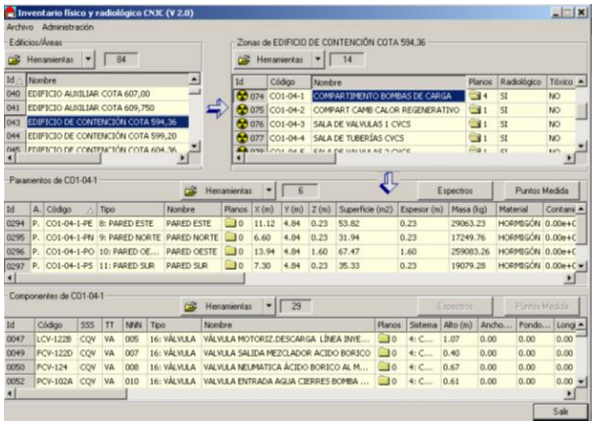
90s — 2003-2005 — 2015-2016

JOSÉ CABRERA NPP DB & 3D MODEL

Vandellós I → Experience → Development of computer tools in order to optimize the engineering works of the decommissioning project

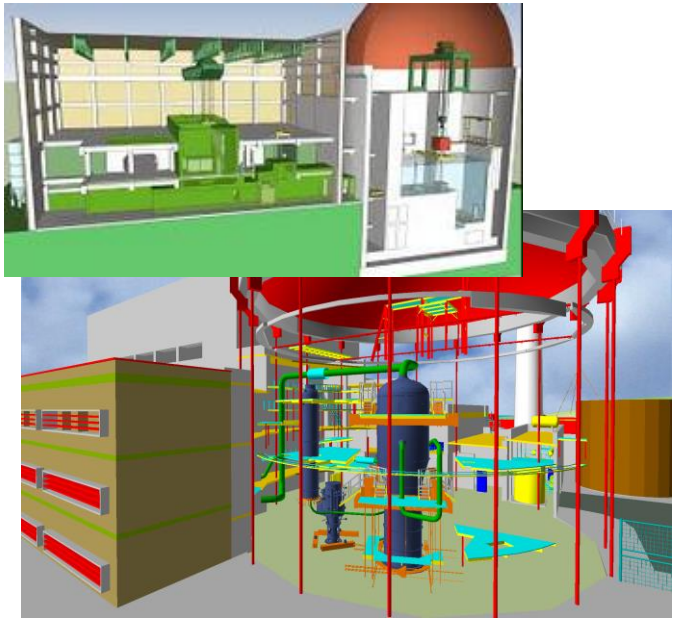
DB

- **Structures:** Walls, floors, buildings, etc.
- **Components:** Valves, pumps, pipes, etc.
- **Data for D&D activities**
- **Other data:** Drawings, photos, etc.



3D

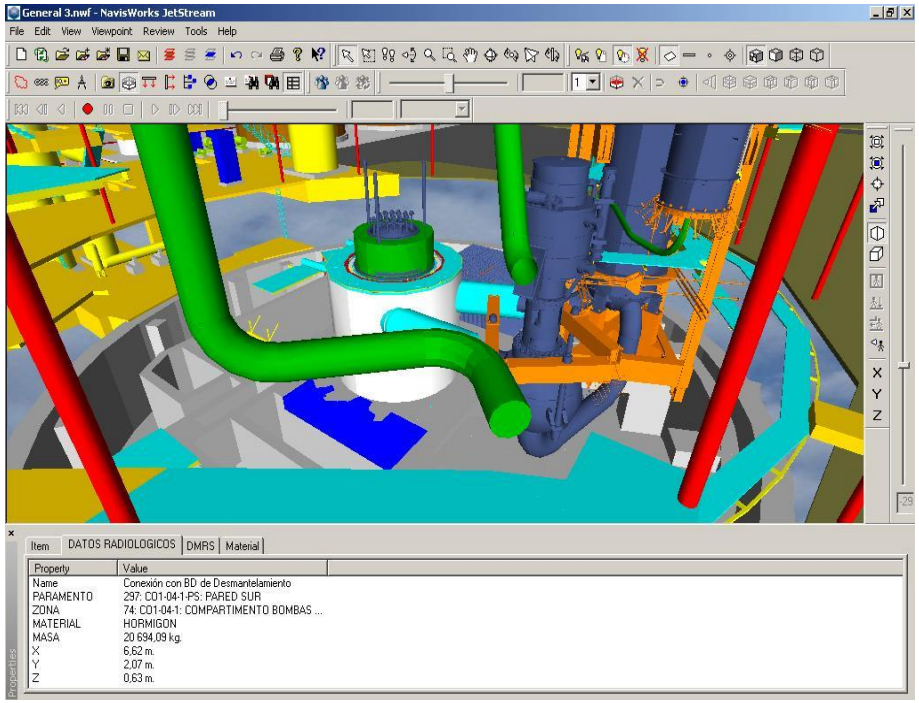
- **Main elements of the NPP**



90s 2003-2005 2015-2016

DB + 3D

The 3D model was connected to the Data Base



Results:

- Intelligent model
- Integration of all the available Information
  - Physical, radiological, 3D graphical
- Exploitation of the model
  - Virtual classification and quantification of materials in the NPP
  - Calculation of the systems and installations needed for the D&D
  - Planning of activities
  - Training
  - Communication
  - Strategies selection

90s — 2003-2005 — 2016-2018

SM GAROÑA DB & 3D MODEL

Simultaneous development of BIM/3D model and Data Base

Microsoft SQL Server

Modeling

AUTODESK® REVIT®

Dynamo

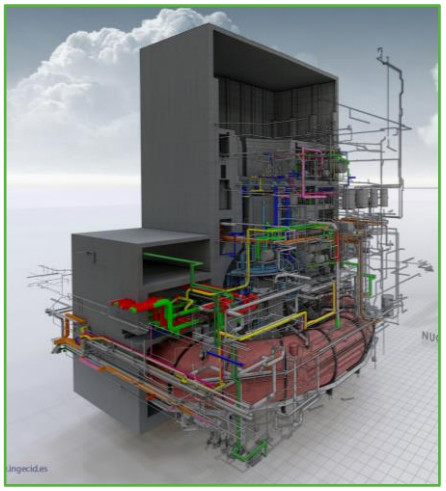
API

Design review & coordination

AUTODESK® NAVISWORKS®

Not modeled data

Muestras radiológicas



BIM Model Elaboration

BIM Model: 3D model with Information attached to the different elements

IFC + Nativo

· Drawings
· Physical Inventory

Microsoft SQL Server

DB: nuclenor

AERI : Radiological characterization

...

90s 2003-2005 2016-2018

SM GAROÑA DB & 3D MODEL

Modeling

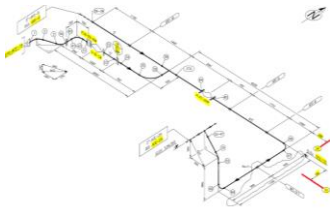
AUTODESK® REVIT®

Dynamo

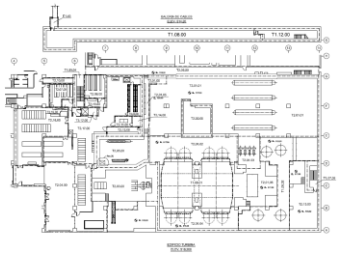
API

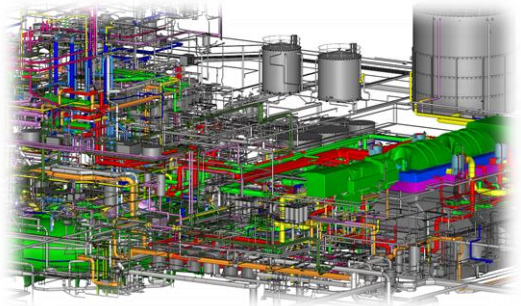
→ BIM Software: 3D + Information

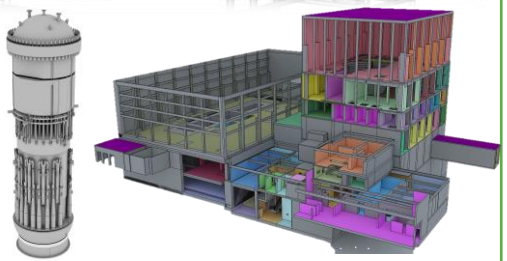
→ Automatization of modeling + attachment of information process



Drawings







Advantages

- Model of all the systems, buildings and components
- Properties of each element attached to its representation
- Location of all the elements by zone
- Filtering and location of elements by zone, system, size, radiological contamination
- Visualization of all the elements in 3D
- Compatibility with other software

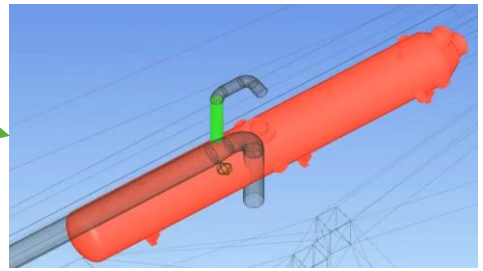
90s 2003-2005 2016-2018

SM GAROÑA DB & 3D MODEL

Design review & coordination

AUTODESK® NAVISWORKS®

- Multiple discipline coordination
- Design review in situ (Photo)
- Design review with 3D Scan
- Clash detection between disciplines

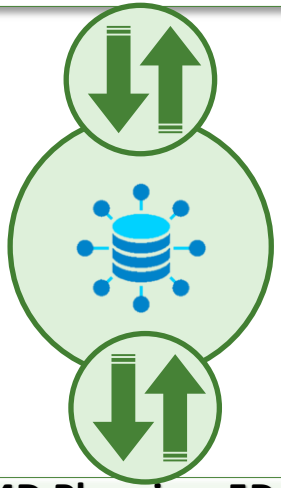


Exploitation of the model and Database: **Uses of the Data**

- Document management
- Connection with other database: AERI, SITA, …
- Drawing elaboration
- Tracking of components included in an container
- Radiological Inventory
- Generation of tables

Microsoft SQL Server

BIM/3D Model



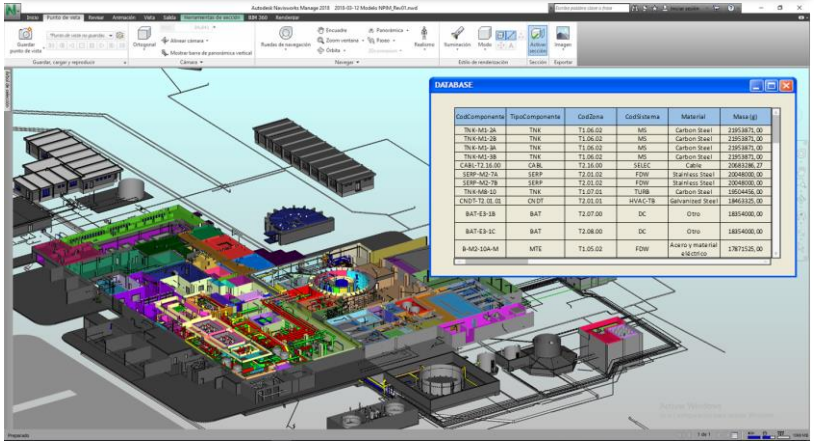
4D Planning, 5D Budgeting and Monitoring

AUTODESK NAVISWORKS

- Physical inventory
- Location of components
- Waste management and estimate
- Consult component information
- Synchronisation 3D and DB
- Export data to Excel and Access

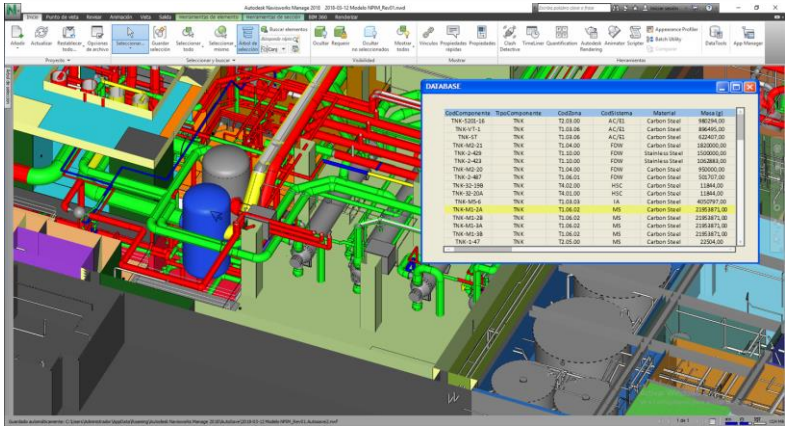
Exploitation of the model and Database: **Uses of the Data**

Synchronisation 3D and DB

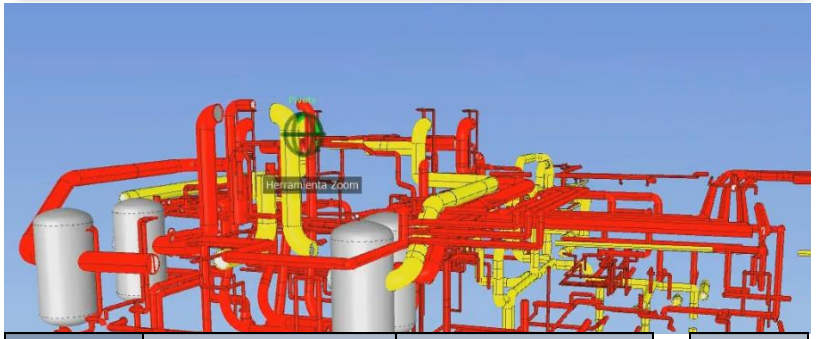


Consult components information

Location of components

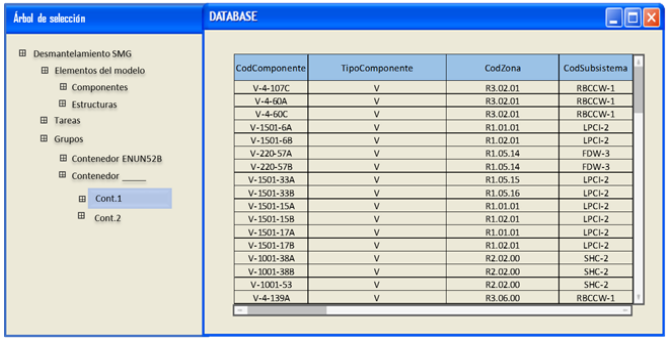


Waste management and estimate



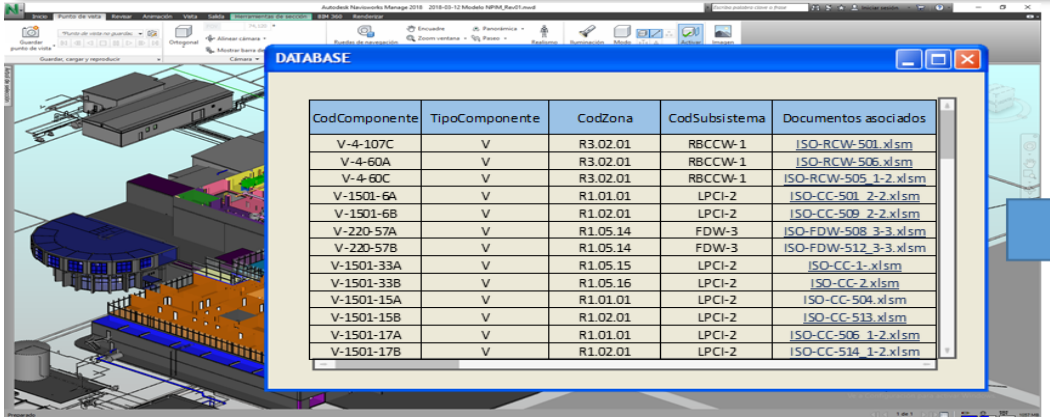
Longitudes (m)	Tuberías	Codos	Total
TURBINA	2663,49	921,03	3584,52
REACTOR	316,73	88,40	405,14
Total	2980,22	1009,44	3989,66 (m)

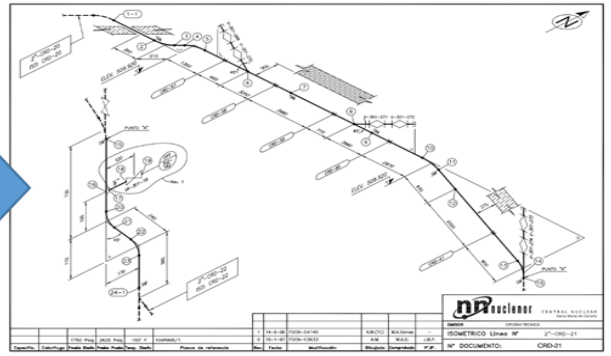
Tracking of components included in a container



Exploitation of the model and Database: **Uses of the Data**

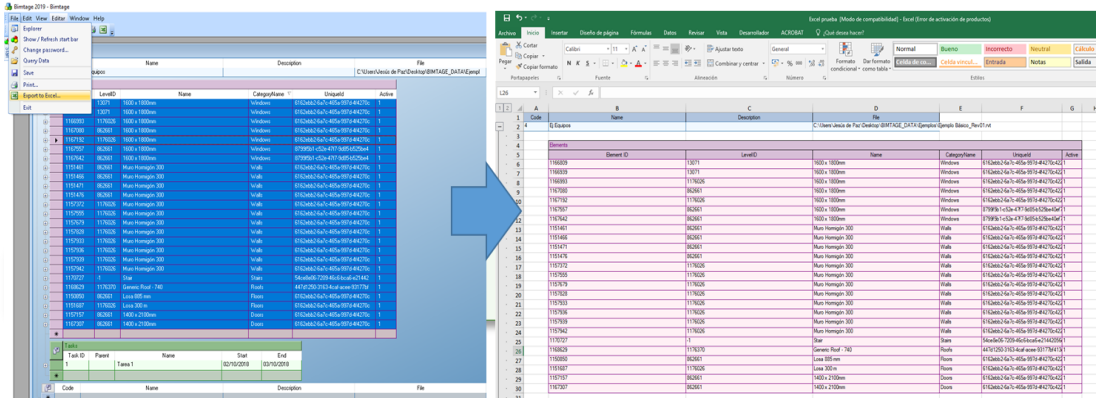
Document management





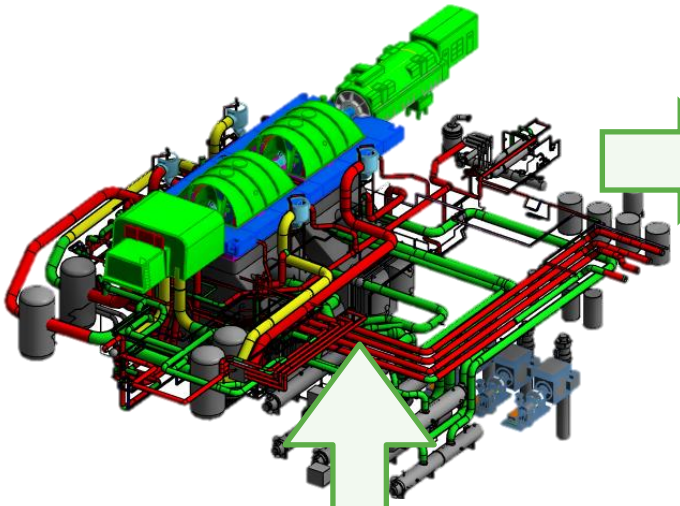
Drawing elaboration

Export data to Excel and Access

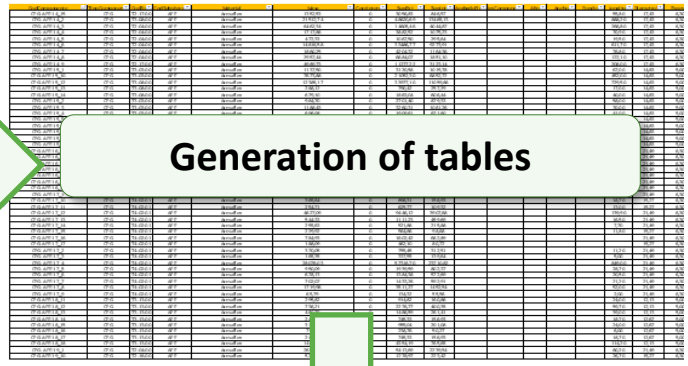


Exploitation of the model and Database: **Uses of the Data**

Physical inventory

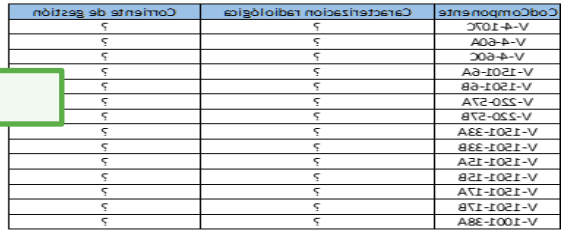


Generation of tables



Connection with AERI

Radiological Inventory

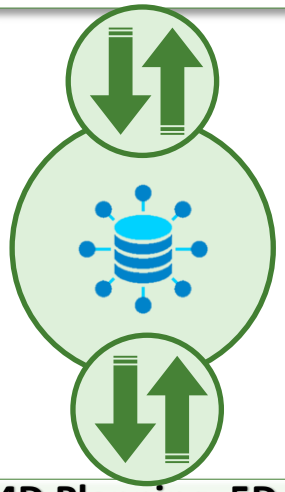


Exploitation of the model and Database: **Planning & monitoring**

- Planning optimization
- Detection of interferences
- Resources management
- Budgeting management
- Space management
- Planning support

Microsoft SQL Server

BIM/3D Model



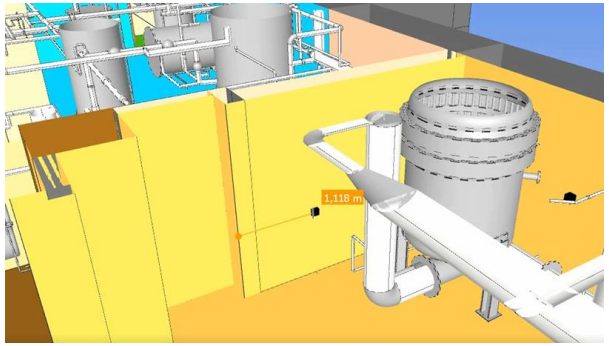
4D Planning, 5D Budgeting and Monitoring

AUTODESK NAVISWORKS

- Planning monitoring
- Budgeting monitoring
- Tracking of components
- 4D simulations
- Design modifications support

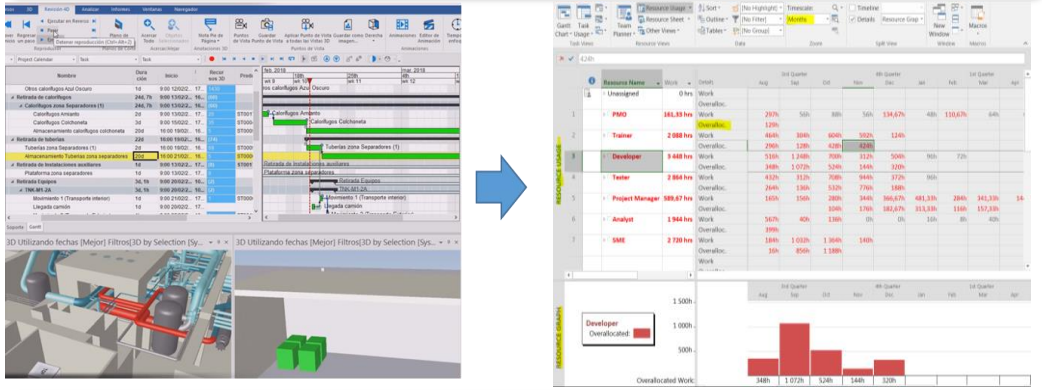
Exploitation of the model and Database: **Planning & monitoring**

Detection of interferences

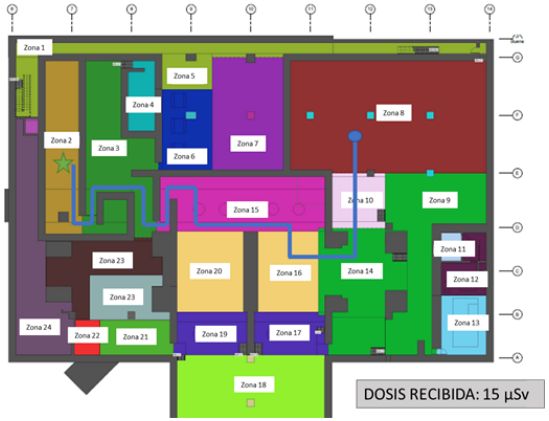


Planning optimization

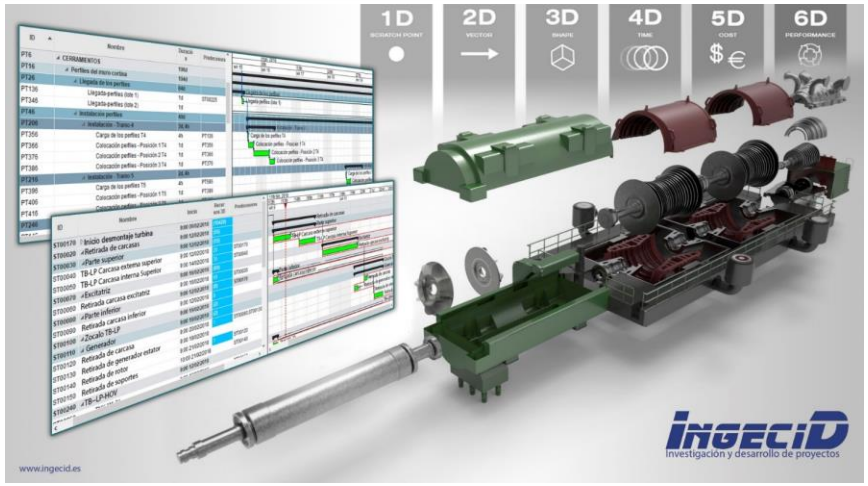
Resources, Budget and space management



Planning support



4D Simulations

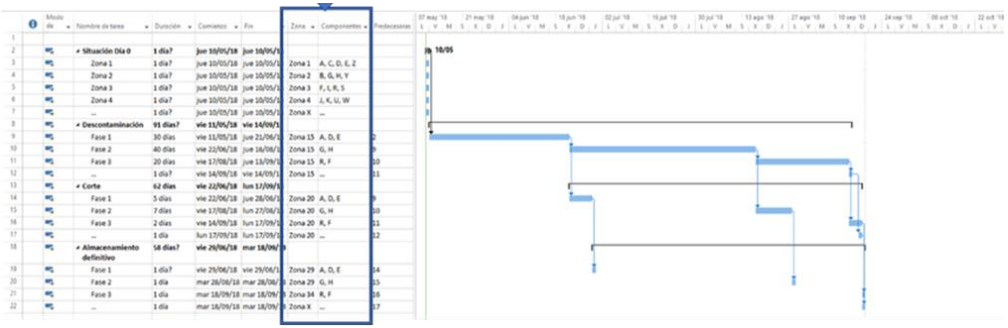


Exploitation of the model and Database: **Planning & monitoring**

Planning monitoring

Tracking of components

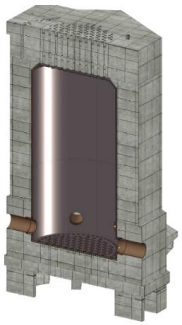
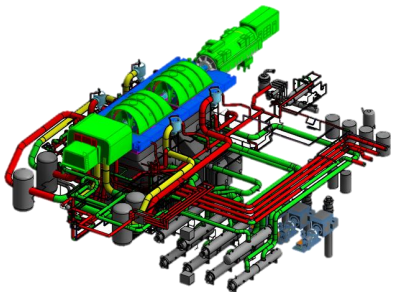
Componentes	Fecha de retirada	Masa	Masa acumulada
TNK-1-47	07/08/2020	22504,00	22504,00
TNK-1-48	08/08/2020	22504,00	45008,00
TNK-1732	09/08/2020	1030623,00	1075631,00
TNK-D-004	10/08/2020	294835,00	1370466,00
TNK-D-006	11/08/2020	204207,00	1574673,00
TNK-M25-53	12/08/2020	250000,00	1824673,00
TNK-M25-55	13/08/2020	176990,00	2001663,00
TNK-M25-52	14/08/2020	28119,00	2029782,00
TNK-2001-2115	15/08/2020	256512,00	2286294,00
TNK-2001-1271	16/08/2020	115422,00	2401716,00
TNK-M5-5	17/08/2020	2113711,00	4515427,00
TNK-4-1353	18/08/2020	200000,00	4715427,00
TNK-4-1037	19/08/2020	106705,00	4822132,00
TNK-M8-10	20/08/2020	19504456,00	24326588,00
TNK-M8-25	21/08/2020	1556184,00	25882772,00

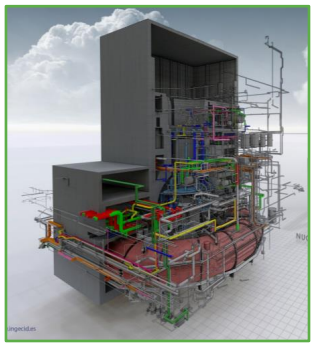
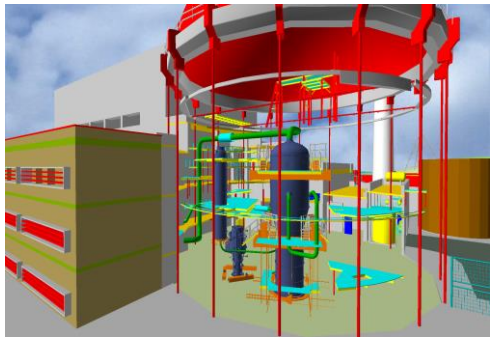


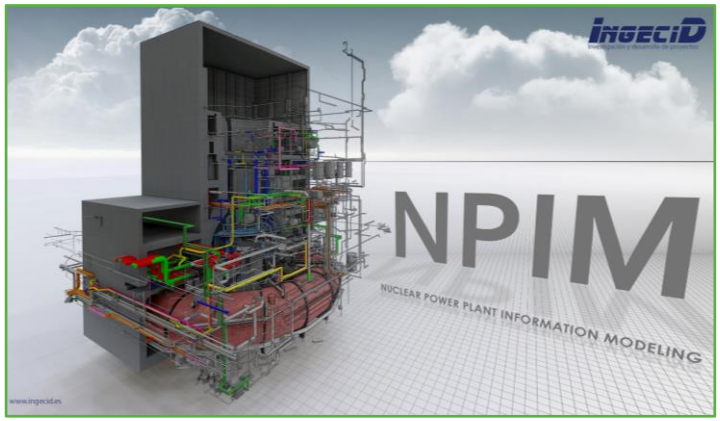
Conclusions

In Spain, the digitization of nuclear power plants has been progressively implemented, making the dismantling processes more efficient and safer. The main advantages of using NPPIM methodology are:

- Reduction of mistakes when modeling, given that the information of the SSC (system, material, codification, etc.) is automatically introduced in the model, to later carry out a verification of geometry by means of 3D scanning point clouds.
- Employment of commonly used and consolidated BIM software that allow their interoperability with other software and the development of APIs in order to automate modeling process
- Large capacity of the integrated database in terms of data, models and document management that allows obtaining information according to the needs of each user



Use of NPP Information Modelling for :

- radiological characterization,
- waste estimation and
- planning removal of components

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Thanks for your attention